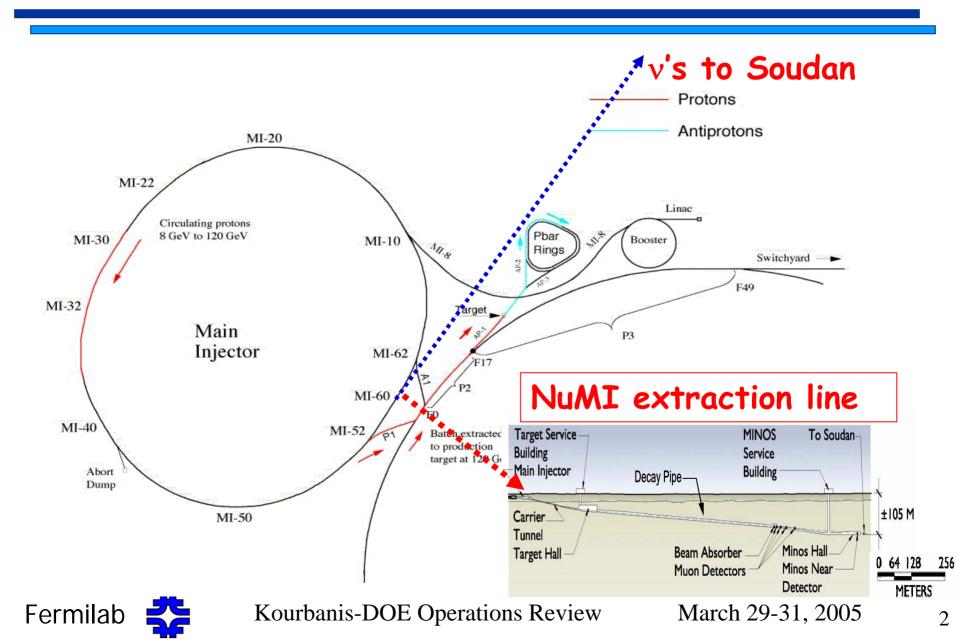
Review of MI operations and Future Plans

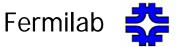
Ioanis Kourbanis March 30, 2005

MI in 2005



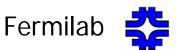
Outline

- Introduction
- Experience with NuMI Operation
- Monitoring and Controlling Losses
- MI Upgrades
 - Rf upgrade
 - Large aperture Quads
 - Collimators



Introduction

- Slip Stacking become operational after the FY04 Shutdown. We are currently achieving about 90% of our design intensity on target but losses are an issue.
- We have implemented and have been running with mixed mode MI cycles (slip stacking+SY120, slip stacking+NuMI).
- The total MI beam intensity can be as high as 3.5E13p/cycle and is expected to increase to about 5.5-6E13p/cycle with the implementation of beam stacking for NuMI.



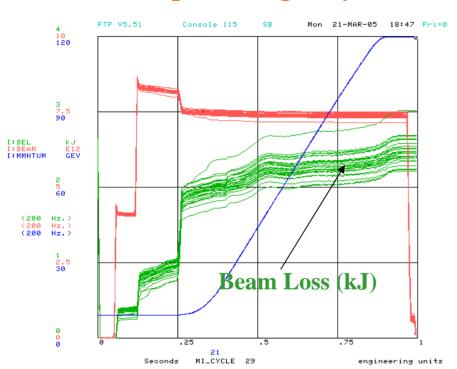
Experience with NuMI Operation

- Since March 17 we have been running NuMI in mixed mode with slip stacking.
 - We have run up to 1.1E13 p/pulse to the NuMI target with a .33 Hz rep. rate.
 - Achieved a max of 1.3E16 p/hr.
 - Starting the week of March 28 we will be running at the pbar stacking rate.
- We are currently concentrating in understanding and reducing the losses in MI.
 - So far we are dominated by slip stacking losses.
 - Left over beam from slip stacking can affect losses in the NuMI beamline.

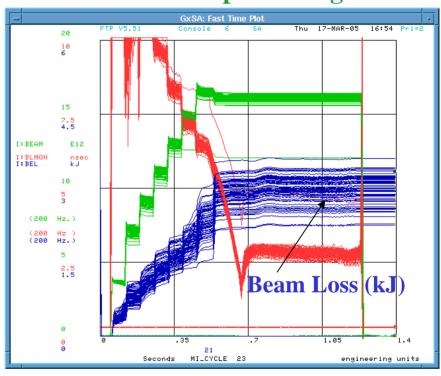


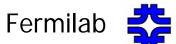
Comparing NuMI Mixed Mode with Slip Stacking **Only**

Slip Stacking Only

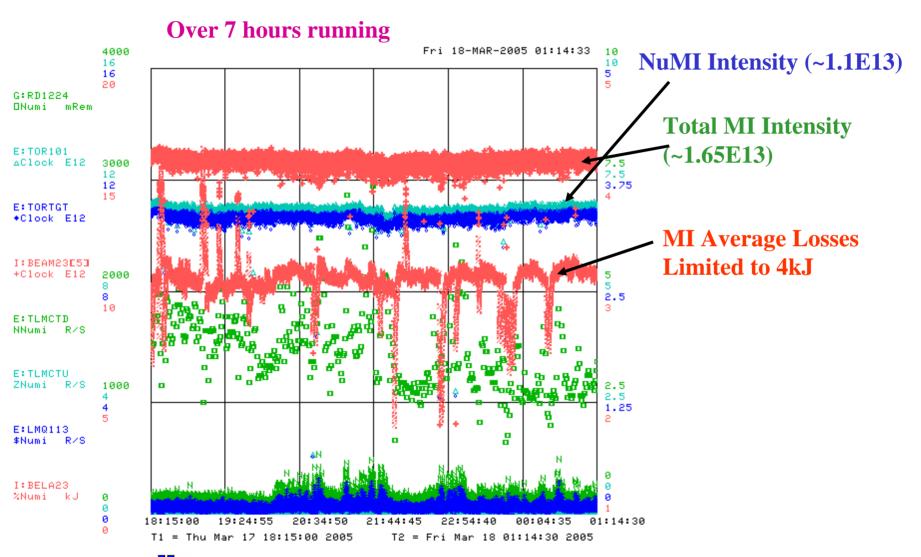


NuMI and Slip Stacking



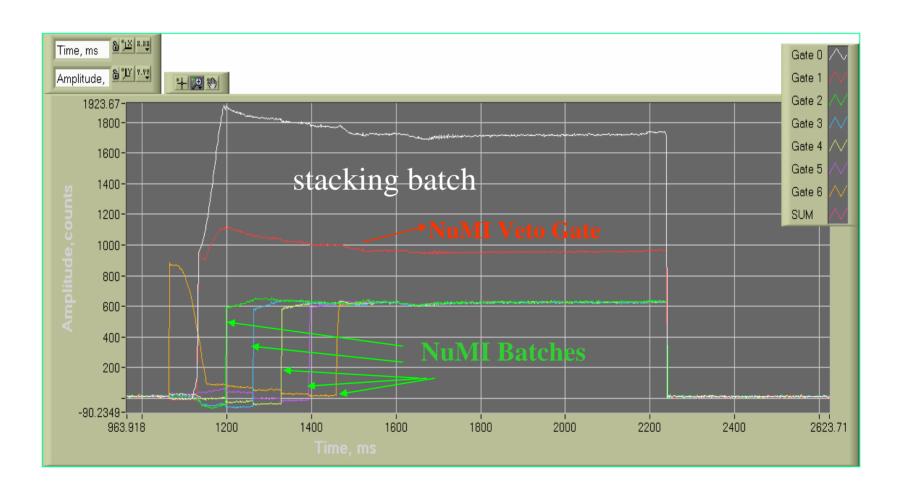


NuMI Running Stability





Batch by Batch Intensities

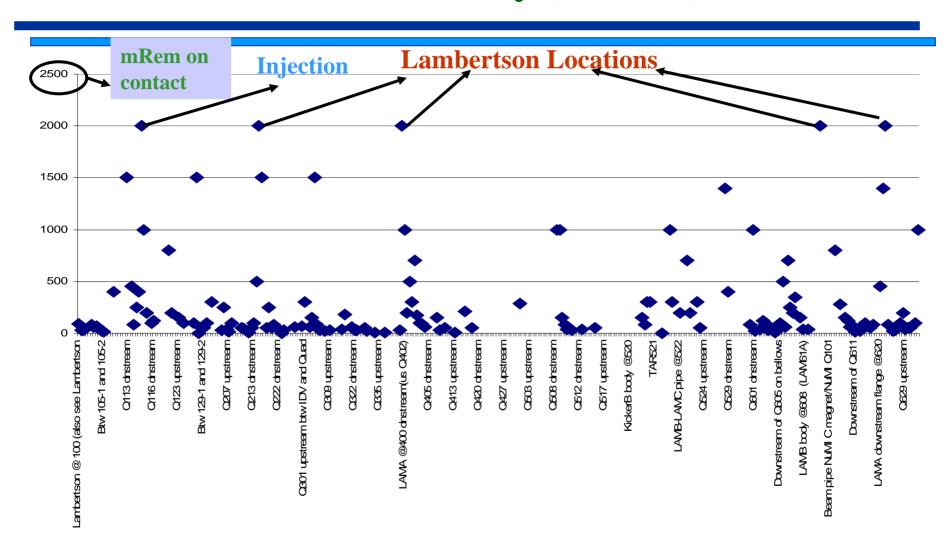


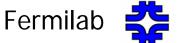


Monitoring and Controlling Losses

- We are currently have a watt meter integrating beam losses in every MI cycle based on a beam toroid signal. We are limiting our average losses per cycle to 4kJ.
- We have been performing rad surveys in the MI tunnel to check component activation and calibrate the watt monitor.
- We are upgrading our loss monitors to provide us with on line integrated loss information during each cycle.

MI Rad Survey (Jan. 05)





MI Upgrades

- We plan to increase the MI intensity by using slip stacking for NuMI.
 - Barrier bucket stacking is also an option
- Stacking more batches in MI will increase the MI cycle time making the accelerating rate critical.
 - Currently the PS can support a max pdot of 280 GeV/sec
- A series of upgrades are planned to help us achieve those goals.

MI RF System

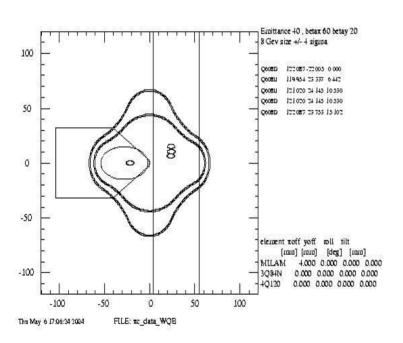
- The existing MI rf system does not have enough power to accelerate the beam intensity required.
- We can increase the rf power available by adding another power tube to each cavity. The cavities have an extra port available. See John Reid's talk.
- We can add more cavities to increase the rf voltage needed for faster ramps (we have 3 spare cavities).

Wide Aperture Quads (WQB)

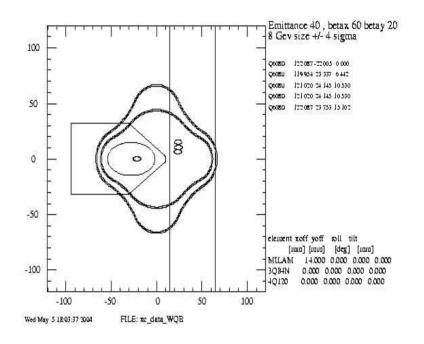
- In all of the MI extraction areas the quadrupoles upstream of the Lambertson magnets limit the physical aperture leading to beam loss.
- We plan to replace these quadrupoles with larger aperture ones (4in instead of 3.3in).
- The first of these quadrupoles will ready for magnetic testing in early May.
- We expect to have 4-7 of the WQB magnets ready for installation during this year's shutdown.

Beam Profiles with the old and WQB quads

Old Lambertson Location

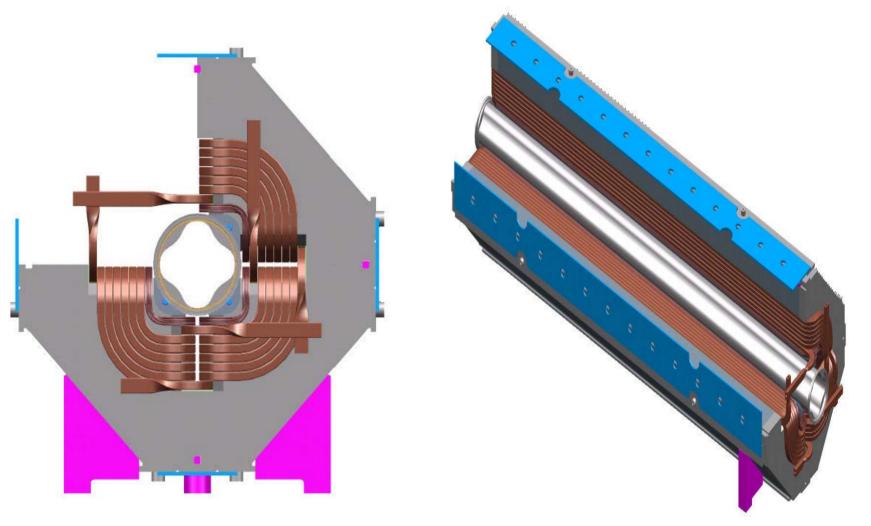


Proposed Lambertson Location



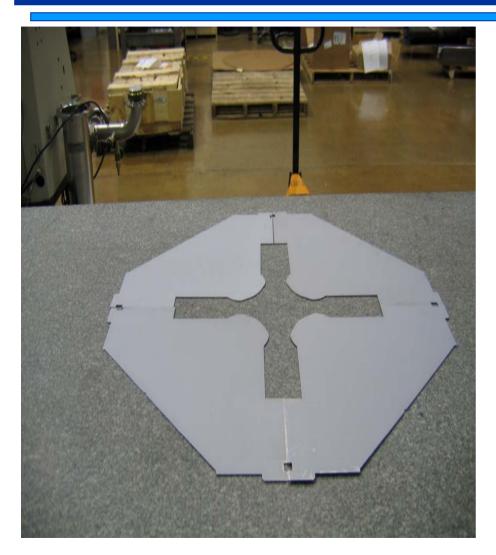
Fermilab

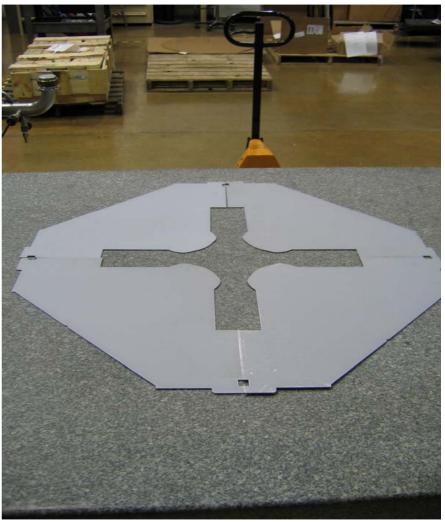
WQB Cross Sections





WQB Laminations





Coils of the first WQB magnet







MI Collimation System

- An MI collimation system that gets rid of beam not captured during slip stacking will be needed in the immediate future.
- We plan to start simulation of an MI collimation system this summer.
- We are planning also to install a set of scrapers in MI-8 injection line during this Summer's shutdown.

CONCLUSIONS

• We have commissioned a slip stacking+NuMI cycle and we are working on increasing the intensity.

 We have developed a system to monitor and control the MI losses.

• We have planned a series of upgrades to help MI further increase the NuMI intensity.

Main Injector Residual Radiation on Contact

